

Interrelationship of Poverty and Disease

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CLEARLY, poverty and disease are bedfellows, yet the precise relationship of one to the other continues to be unknown. Does poverty spawn disease? Or are people impoverished because they are sickly?

Kimble (1), in his remarkable study on tropical Africa, has said, "It is bad enough that a man should be ignorant, for this cuts him off from the commerce of other men's minds. It is perhaps worse that a man should be poor, for this condemns him to a life of stint and scheming, in which there is no time for dreams and no respite from weariness. But what surely is worst is that a man should be unwell, for this prevents his doing anything much about either his poverty or his ignorance."

This paper examines recent material dealing with poverty and disease, particularly in the United States. And an attempt is made to establish a useful perspective on this most difficult and baffling subject.

For nearly a century there has been spirited pursuit of proof that housing quality affects health. Housing quality is subject to relatively precise measurement and health status also is measurable, yet mathematical proof of a cause-and-effect relationship between housing and health so far has eluded students of the subject.

The relationship between poverty and disease is even more complex, but it is generally believed that they are related, and there are facts to back up this belief.

General Observations

Historically, the healthiest nations have been those with the highest incomes and the lowest illiteracy rates. At the beginning of this century life expectancy at birth was greater in the

United States, Great Britain, and the Scandinavian countries than it is today in many parts of the world. Yet, as late as 1955, India had the same life expectancy at birth, 35 years, as existed in Massachusetts and New Hampshire in 1789 (2), and in 1957, even though the reported birth rates for the two countries were about the same, life expectancy for the newborn in the United States was 70 years, twice that for India.

Data like these abound but they are of little avail in determining the relationship between poverty and disease. We cannot measure the precise influence on health of each of the numerous factors that are comprehended by the word "poverty." In this paper I have used the term "low income" to denote poverty, but even this rough symbol may be suspect since in the United States a yearly income of \$2,000 is regarded as low, whereas half the population of the world has an annual income of \$200 per capita.

Communicable Diseases

Throughout history communicable diseases have struck most severely among the poor. Even today, it is the serious communicable diseases that present the greatest threats to the health of people in underdeveloped lands. Many diseases that are virtually unknown or nonexistent in the United States and other economically favored nations are the main

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causes of death and disability among large population groups elsewhere on the globe.

Communicable diseases are caused by living organisms—bacteria, viruses, protozoa, and the like. These diseases may result from a single infection produced by direct contact, ingestion, inhalation, or injection, and they may be prevented by artificial or natural immunity or by the establishment of environmental barriers between the infecting organism and the non-immune host. These are the kinds of diseases whose control implies an understanding of the germ theory of disease, a sanitary environment, uncrowded living conditions, and satisfactory nutrition.

Typhoid Fever

An example of what can be done in the control of an important communicable disease is the practical control of typhoid fever in the United States.

Individual immunity to typhoid fever results either from infection or vaccination. Typhoid vaccine is demonstrably effective. However, it serves best as a temporary preventive and does not replace sanitary measures for effective control. Furthermore, the vaccination rate varies significantly by locality, age, and sex, and nowhere is it high. With the exception of members of the armed services, Americans are not effectively immunized against typhoid fever. For the civilian population, vaccination has not been a prime factor in controlling this disease.

There is ample evidence that typhoid fever occurs as the result of inadequate or poor sanitation. Thus, we might assume that elimination of sanitation hazards would be paralleled by a reduction in the typhoid fever rate. Experience supports such an assumption. As the standard of living has risen—we may take as an index the increase in the percentage of households with inside running water and flush toilets—typhoid fever has become less prevalent.

Yet typhoid fever has become a rare disease not alone because today's poor may be better off than their counterparts of years gone by. Rather, this public health feat has been accomplished through a combination of circumstances. With the increase in urbanization has come greater utilization of community water supplies.

Fewer Americans than ever before, proportionately and absolutely, are today dependent on potentially unsafe private wells and cisterns for their drinking water. Even the poorest city dwellers have ready access to the municipal water supply, which is usually piped into the house. They no longer have to haul water from the neighborhood pump or well, which all too often was contaminated. Furthermore, the application of scientific purification measures has made public water supplies in this country about as safe as any in the world.

Typhoid fever is a disease that has succumbed to a continuing rise in the standard of living, accompanied by widespread improvement in sanitation of the environment. And it is the poor who have benefited most.

Poliomyelitis

Poliomyelitis is a communicable disease whose spread may or may not be associated with faulty environment. So far as is known, it does not normally attack one socioeconomic group more often than another.

Prior to the introduction of Salk vaccine, epidemic poliomyelitis cases tended to be scattered widely and relatively uniformly throughout the community without preference for any socioeconomic group (3). Recently, however, an inverse correlation between income and the incidence of poliomyelitis has developed. The 1960 epidemic in Providence, R.I., was noteworthy especially for its concentration of cases in census tracts classified as lower and lower-middle class from a socioeconomic standpoint. These are the neighborhoods of large families, often severely crowded in their dwellings. Conversely, upper economic areas were remarkably spared. Persons living in the high-income areas, in addition to their less crowded living conditions, were significantly more frequently vaccinated than those in poorer sections of the city.

Community surveys have shown that immunization rates for diseases such as poliomyelitis, diphtheria, and whooping cough are a function of socioeconomic status—the higher the socioeconomic class, the higher the level of immunization. These findings have been consistent the country over.

According to Sirken and Brenner (4), among

persons under 50 years of age, the poliomyelitis vaccination rate was twice as high, on the average, among individuals in families with incomes of \$7,500 and over as among persons in families whose income was under \$3,000. However, this direct correlation between income and frequency of vaccination is much more marked for the white than for the nonwhite population. In fact, among nonwhite school-age children, vaccination was not correlated with income. Persons living in families with an income under \$3,000 received most of their inoculations at work or at school, yet mass poliomyelitis vaccination programs failed to reach more than roughly a third of the target population. Efforts are being made to determine the reasons for the apparent weakness of mass vaccination programs.

Tuberculosis

Tuberculosis is a disease that not only is most prevalent among the poor, but also causes serious economic distress.

Since the highest tuberculosis incidence occurs among slum dwellers, some investigators have cited substandard housing as a prime causative factor. Others dismiss housing quality as being only symptomatic of the so-called slum complex.

It has been held, also, that diet plays an important role in determining the relative susceptibility of individuals to tuberculosis, and that the malnourished are especially susceptible. One of the principal proponents of this theory (5) has said, "I cannot resist the temptation to express my belief that . . . it is most unlikely that drugs alone, or drugs supplemented by vaccination, can control tuberculosis in the underprivileged countries of the world as long as their nutritional status has not been raised to a reasonable level."

Although the exact role of either housing or nutrition in the epidemiology of tuberculosis is unknown, it may be assumed that the improved standard of living of the American people has contributed materially to reducing the incidence of the disease. Indeed, Lowell (6), after detailed study of the tuberculosis problem in New York City, concluded that "if optimum benefits are to be realized in mastering tuberculosis, progress in medicine and public health must

be accompanied by comparable and parallel socioeconomic improvements in living conditions."

Before discussing some of the relationships between poverty and noncommunicable diseases, I will recapitulate the main points made so far.

There are two pertinent lessons to be learned from the oversimplified portrayal of the decline of typhoid fever in the United States. First, a rise in the standard of living of low-income families may reasonably be expected to strengthen the defenses against diseases spread through faulty environment. Second, when specific preventive measures are available, their application through organized community effort will break the chain of infection, thereby leading inexorably to disease control. Typhoid fever is a disease for which community action has been a basic factor in control.

In contrast, poliomyelitis is a disease for which individual action, namely, the seeking of vaccination, is of prime importance in establishing control. Poliomyelitis is increasingly a disease of low-income families. The question is: Why do low-income families not avail themselves of opportunities to be vaccinated? The evidence shows that cost alone is not the deterrent.

The decline of tuberculosis undoubtedly has resulted from mixed and probably overlapping causes. Up to now, BCG vaccination has not been used enough in the United States to have had a significant impact on the epidemiologic picture. Effective casefinding through public health action, isolation of active cases, and efficient therapy have removed many sources of infection. The question remains, however: What has been the role of improved living conditions, including better nutrition, in this change?

Noncommunicable Diseases

The comparative conquest or amelioration of communicable diseases has contributed materially to the prolongation of life in the United States. As man lives longer, however, he becomes more liable to attack by those chronic and degenerative diseases usually associated with adult life. Yet, with the exception of mental illness, relatively little attention has been paid

to the role of socioeconomic factors in chronic and noncommunicable diseases.

Cancer

Morbidity data collected by the National Cancer Institute in 10 metropolitan areas of the United States were analyzed by Dorn and Cutler with a view to determining the relationship between socioeconomic status and cancer incidence (7). They demonstrated that cancer incidence in the lowest income group is 15 percent above the average for all income groups; and that for all forms of cancer combined, incidence is inversely related to income. This association is not limited to occupational exposure since it occurs among women as well as among men. They suggest that factors such as diet, personal habits, and general environmental conditions are probably involved, and that genetic influences also may be implicated.

Buell and his co-workers have reported on the deaths of 10,401 California men aged 20-64 years who died of cancer in 1949-51 (8). In their study, laboring men, that is, those in the lower social classes, had a significantly higher mortality risk from cancer of the stomach, esophagus, or buccal cavity and pharynx than did those in occupations with usually high incomes. Their study also brought out the generally higher mortality risk for laboring men from diseases other than cancer.

Buell and his associates observed that "while it is possible that lower socioeconomic status carries exposure to a higher risk for a number of diseases, the reverse may also be true. . . ." They go on to note that, in the case of cancer, the clinical history of most cancers is so short as to make it reasonable to reject the hypothesis that the disease causes the low socioeconomic status. To this observation one might add that cancer may still be a very expensive illness.

Evidence has been accumulating that the incidence of cancer of the cervix is inversely related to socioeconomic status. Stocks has shown that the death rate for uterine cancer among married women in England and Wales increases as social class decreases (9). Logan has confirmed this observation but has shown simultaneously that mortality from cancer of the breast increases as socioeconomic status rises

(10). Similar observations were made by Dorn and Cutler in the report cited (7).

Premature Births

Rider and co-workers have shown a distinct association between premature birth and socioeconomic status (11). In Baltimore, among 27,979 births to white mothers in 1950-51, frequency of premature births was significantly higher among mothers in the lower socioeconomic strata. Additionally, the prematurity ratio for all nonwhites (11.3 percent) was considerably above the ratio (7.3 percent) for the lowest socioeconomic tenth of the white group. These authors point out that "it is not unlikely that this latter difference is also associated with a corresponding difference in socioeconomic level."

Accidents

Data on personal injuries collected by the National Health Survey during 1957-58, analyzed by Gentile (12), show a high inverse correlation between family income and number of restricted activity days, a measure of accident severity. Males in families whose income was less than \$2,000 had an average of 5.4 days of restricted activity in contrast to only about 2 such days for males in families with incomes of \$7,000 or more. Males in the group with incomes of \$4,000-\$6,999 had 1.8 restricted activity days. Although females generally had fewer accident-caused restricted-activity days than males, females in the highest income group had slightly more such days than males in the same income group. The rate for females in the lowest income groups was 3.5 days per person per year compared with 1.6 days in the income group \$4,000-\$6,999 and 2.2 days for those with incomes of \$7,000 or more. The question may be raised: Are the poor especially subject to severe accidents or is their income status a result of their incapacities?

Although accident severity, as shown by the above data, is inversely related to income, accident frequency rates apparently increase with income. I say "apparently" because the experts believe that there is a positive correlation between educational level and reporting of minor health conditions. Without regard to

this possible reporting bias, National Health Survey data show 22.7 accidental injuries per 100 persons per year among families with incomes under \$2,000, and 32.7 such injuries per 100 persons in families with incomes of \$7,000 and over.

Chronic Conditions

Disregarding specific disease entities, Gleeson studied the 1958 prevalence of "chronic conditions" among the noninstitutional population of the United States (13). Four out of every 10 persons had one or more "chronic conditions." Of these approximately 70 million persons, 13.5 million were limited in the amount or kind of their major activity, such as work, school attendance, and keeping house, or in their pursuit of outside activities. Another 3.5 million could not carry on their major activity. Thus, 1 American in 10 had some long-term limitation of activity due to chronic illness or impairment.

The prevalence of chronic limitation of activity and mobility was inversely associated with family income. About 1 person in 5 in low-income families had an activity-limiting condition, while only 1 in 14 of those in high-income families was so afflicted. Mobility limitation was proportionately six times as frequent among persons in low-income families as in families having \$7,000 or more annual income.

These relationships between income and limitation of activity and mobility were consistent for each age group studied, although the frequency rate for "chronic conditions" rises rapidly after age 45. The highest rates are among those 65 years old and over in families having less than \$2,000 annual income. As the survey report indicates, however, "There is no way to determine from these data the extent to which family income and chronic limitation of activity are causally related, nor is it possible to determine whether low income is responsible for the chronic disability or vice versa."

Dental Conditions

Chope and Breslow have reported on the relationship of income to loss of teeth among apparently healthy Californians age 50 years and over (14). These authors show a significantly

high correlation between low economic status and the loss of teeth among older adults, a fact recently confirmed by the National Health Survey. It has been suggested that excessive loss of teeth among adults of low income may be explained by both poor diet and inadequate dental care.

Various investigators have shown a positive correlation between less serious dental defects and low socioeconomic status. However, studies among groups with extremely low incomes in various countries around the world show no consistent pattern of dental defects and suggest that poverty is not necessarily accompanied by poor teeth.

A 1958 study of 491 preschool children in Brookline, Mass., showed no significant relationship between socioeconomic levels and malocclusion (15). In that study Calisti and his co-workers brought out an interesting sidelight on the incidence of such conditions as finger sucking, fingernail biting, and tongue, lip, or cheek habits. Such habits were observed significantly more frequently among children in high-income families than in those from low-income homes. The "why" of these differences is, in the authors' words, "a subject for future investigation."

In comparing material on the relationship of poverty to chronic disease with material on the relationship of poverty to communicable diseases, it is evident that there has been less thorough study of the former and that the known facts are less persuasive. At this point in time, probably the most that can be said is that the role of poverty in chronic disease is not well understood.

Social Consequences

Apart from the actual incidence of disease as it relates to socioeconomic status, the impact of disease on the ability of the wage earner to work or of the child to attend school is a matter of general concern.

Bergsten has shown an inverse relationship between family income and time lost from work due to illness and injury. Her report shows that "usually working" persons in families with annual incomes of less than \$2,000 lose an aver-

age of 10.3 days from work per year compared with only 5.9 days for "usually working" persons in families with incomes of \$7,000 or more (16).

For all days of restricted activity, that is, reduction in usual pursuits due to illness and injury, the rates ranged from 32.4 days per person per year among persons in families with incomes of \$2,000 and under to 16.5 days for persons in families with incomes of \$4,000-\$6,999. There was virtually no difference in the rates for persons in families whose income was between \$4,000 and \$7,000 and those in higher-income families.

Bergsten offers a possible explanation of the higher incidence rates for restricted activity days among persons in lower-income families. She suggests that (a) they are more subject to restricting illness because they use medical care less frequently and have poorer diets than those who are economically more favored; (b) they have lower incomes because of their illness; (c) they are unemployed or are not seeking employment because they are in poor health; and (d) those who are employed might tend to work less or to take poorer paying jobs because of their health problems.

The number of bed-disability days, also, is inversely related to income. Persons in low-income families averaged 12.2 days of bed-disability per year compared with 6.0 days for persons in families whose income was \$7,000 or higher. Females consistently averaged more bed-disability days than males, although the disparity grew with increase in income.

With regard to sex differences in work-loss days, in low-income families the rates were higher for males than for females. Among persons in high-income families, "usually working" females lost slightly more days from work, on the average, than males. The study revealed no important differences in rates of loss of time from school among children in the various family income groups, the annual average being 8.4 days per child aged 6-16 years.

Bergsten has reviewed sample survey data on a variety of health topics for children and youths under 25 years of age (17). In her analysis she pointed out that, while children in families with incomes under \$4,000 a year had about the same average number of days lost

from school (8.9) as did children from higher-income families (8.2), there was a strong positive relationship between family income and frequency of physician visits. For children 14 years old and under, rates for physician visits in families with incomes of \$4,000 or more were one and one-half times, and for dentist visits three times, those for children in lower-income families.

These observations on the use of health services are discussed in greater detail in the National Health Survey reports. As a measure of the interrelationship of poverty and disease, the use of health facilities and services is a significant index. The survey shows that members of low-income families, when admitted to short-stay hospitals, stay significantly longer than do patients from high-income families (18).

Bergsten, reporting on data collected during July 1957-June 1959, shows that the frequency of visits to physicians is directly related to family income (19). Persons in families having annual incomes under \$2,000 had a rate of 4.6 physician visits per person per year compared with 5.7 visits for persons in families with incomes of \$7,000 or more. There were comparable differences throughout the entire age range. Children through 4 years of age in high-income families had 80 percent more physician visits than did children in families whose income was under \$2,000 (7.6 vs. 4.2).

The total civilian noninstitutional population of the United States in the period July 1957-June 1959 averaged 1.5 dental visits per person (20). But the rates varied greatly among different income groups from an average of 0.7 visit per year for members of low-income families to 2.5 visits for those in families having \$7,000 or more. However, there was an inverse relationship between extraction and denture rates and income.

A positive relationship also has been shown between educational achievement and the rate of use of dental services, regardless of income. Among persons in families whose income was less than \$4,000, the rate of dental visits was approximately twice as high for those whose family head had 9 or more years of school as for those whose head had less education.

A definite relationship between family income and time interval since last dental visit also has

been shown (21). About one person in two among high-income families, but only one in five in families whose income was under \$2,000, had visited the dentist within a year prior to interview. Conversely, 1 individual in 4 among low-income but only 1 in 10 among high-income families has never visited a dentist. Furthermore, the number of persons who have never visited a dentist varied inversely with income and education.

Discussion

The precise relationship between poverty and disease presents many baffling questions. How does the material reviewed above contribute to our understanding of the basic issues?

First, it emphasizes that we lack irrefutable proof that poverty causes disease. Undoubtedly, poverty is a major factor in malnutrition, which, in turn, may reduce resistance to invading organisms such as the tubercle bacillus. However, animal experimentation suggests that poor nutrition, per se, does not seriously affect the course of disease. Poverty also causes people to live under insanitary conditions. These contribute to the spread of some of the infectious diseases, especially diseases of the intestinal tract. But poverty alone causes neither tuberculosis nor typhoid fever. At most it helps to provide the environment in which these and other diseases may flourish.

Second, some of the material suggests that, under certain circumstances, disease may cause poverty. Sickness inevitably imposes a financial burden in the form of charges for health services. In severe illness, this burden can be devastating. Additionally, long illnesses may reduce family income. Indeed, the earning capacity of the breadwinner may be destroyed and economic catastrophe may be visited upon the whole family.

Third, low income is a barrier against the use of preventive medical techniques and services. For example, low-income families are inadequately immunized against preventable diseases, and they use pediatric services less frequently than do high-income families.

Finally, the use of dental care services, possibly the best index of elective health action by families or individuals, is significantly related

to socioeconomic status—the lower the income, the less frequently dentists are seen.

In summary, there is a need for continuing and expanding our efforts to raise the standard of living and to improve educational opportunities. These are the sinews of better health. Without them, no society can be healthy. Poverty and disease go hand in hand, and removing the burden of poverty from the shoulders of the less fortunate will contribute to the health of all.

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High Calcium Diet for Osteoporosis

Scientists at the Public Health Service's National Institutes of Health have found that diets high in calcium may offset the thinning of bones of arthritis patients treated with cortisone and other corticosteroids.

Osteoporosis, a bone-thinning disease marked by excessive calcium loss, principally from the spine, affects 30 percent of women past the menopause and is probably more common among older women with rheumatoid arthritis, according to NIH researchers. The bone disease is known to become worse in patients who receive corticosteroid hormone therapy for relief of arthritis.

Dr. G. Donald Whedon of the National Institute of Arthritis and Metabolic Diseases and his associates, Dr. Leo Lutwak and Preston Smith, performed 13 studies to determine the amounts of calcium lost or gained in 11 patients given different hormone preparations. Despite varying responses, the results gen-

erally support the belief that corticosteroids cause calcium loss.

In two studies large increases of dietary calcium, by supplements of milk products and calcium lactate tablets, produced calcium storage even during corticosteroid hormone therapy. Similar diets given to seven patients with postmenopausal osteoporosis who were not receiving hormones prevented calcium loss in six of the patients and enabled four of them to begin storing it. This suggests that abundant calcium in the diet during adult years may protect the skeleton.

The studies support previous findings that diets high in calcium are not harmful. Moreover, the studies suggest that a high calcium diet is now the most reasonable clinical procedure for protecting arthritis patients from the bone-depleting effects of corticosteroid therapy.